Environmental Measurements Laboratory

Annual Report

FY 2000

A Federal Technical Resource

U.S. Department of Energy
Office of Environment Management
Office of Science and Technology

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EML Service Through Science

Director's Message

I am pleased to provide the Environmental Measurements Laboratory's (EML) FY 2000 Annual Report. Our successes and activities of the fiscal year, highlighted here, demonstrate the vital role we play in many U.S. Department of Energy, national and international programs, sites and institutions.

Through programmatic assistance, technology development, and analytical quality assurance activities, EML provides a unique federal technical capability for DOE site closure and national security issues. Among our highlights in FY 2000:

- Continued cost-savings at the Fernald Environmental Management Project by utilizing EML's methodology of *in situ* gamma spectrometry for post-cleanup pre-certification in an Accelerated Site Technology Deployment project. To date, cost savings have been in excess of $15 million with additional cost savings over the next five years estimated to be about $19 million.
- Completion of prototype innovative instruments for measuring cesium in water in the field using 3M™ Empore Rad disks and for remote monitoring of airborne alpha contaminants.
- Establishment of the International Environmental Sample Archive, a database containing information on environmental samples archived by national and international organizations.
- Construction at EML of the U.S. Radionuclide Laboratory for the Comprehensive Nuclear-Test-Ban Treaty.
- Organizing international intercomparisons of environmental dosimeters and *in situ* gamma-ray spectrometers.
- Completion of the 51st and 52nd Quality Assessment Program, which provides an external, independent performance-based evaluation of environmental radiological measurements for more than 170 participants, including DOE contractor and subcontractor laboratories.

As a unique federal resource with core capabilities in low-level radiation and radioactivity measurements, we at the Environmental Measurements Laboratory are proud to present our successes as we eagerly work on current and future challenges. I encourage you to reach our designated Points of Contact or visit our Web Site.

Mitchell D. Erickson, Director

EML staff

About EML

EML is one of only four government-owned and government-operated laboratories in DOE and is comprised of approximately 60 federal employees. EML provides unique capabilities and many services that contractor laboratories cannot provide, such as helping to set national technical policy, and responds quickly to new issues with objectivity and reliability.

EML provides technical assistance, data quality assurance and program management for measurements of low-level radiation and radioactivity relating to environmental restoration, long-term stewardship of DOE's Office of Environmental Management (EM) sites, global nuclear non-proliferation, and other priority issues for the DOE, as well as for other government, national and international organizations.

EML significantly contributes to the Goals and Commitments of the Secretary of Energy's Performance Agreement with the President in three areas: Environmental Quality, National Security, and Science and Technology. Summary descriptions of EML's FY 2000 activities, categorized according to DOE business lines, are presented with the primary office or program sponsor indicated for each.

The Laboratory, established in 1947, is administered by the Chicago Operations Office and is located in a General Services Administration (GSA) building in Manhattan, New York. The Laboratory also uses a field performance testing area at Brookhaven National Laboratory (70 miles to the east in Suffolk County on Long Island) for special investigations.

The EML Environmental Test Chamber used in FY 2000 to calibrate FEMP's airborne alpha radioactivity monitors, and to test and calibrate the Korea Institute of Nuclear Safety's radon and radon progeny instruments.

The unique, custom and special facilities at EML include:

- Neutron and Gamma-ray Calibration Facility
- Electronics Assembly and Test Area
- TLD Reader Facility
- Sample Preparation Facilities
- Environmental Chamber
- Chemistry Laboratories
- Machine Shop
- Pulse Ionization Chambers for Radon Measurements

Laboratory scientists, engineers, technicians and support staff offer a team-oriented approach that brings a unique federal perspective and capability in meeting national needs.

EML's radiochemistry laboratory where Quality Assessment Program samples are evaluated and certified.

Funding

Our Sponsors:

EM

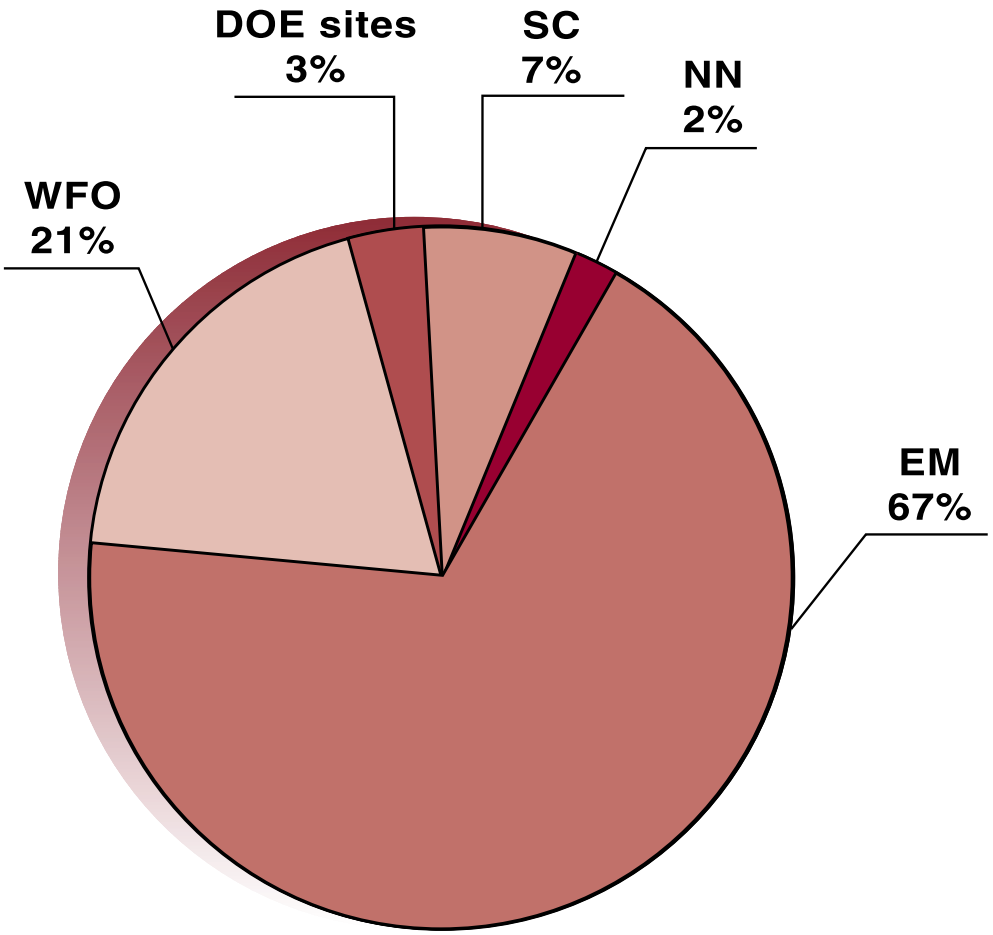
EML's main mission is to support EM's site closure and cleanup completions through: (1) technical assistance to the DOE field offices, (2) activities for the Office of Science and Technology (OST) in the development and deployment of radiological field characterization and monitoring technologies, and (3) performance testing programs for the Office of Safety, Health and Security (EM-5) that provide external oversight of the quality of data used in DOE cleanup activities.

SC & NN

As a federal resource laboratory, EML provides DOE offices with a readily available and objective in-house capability in support of their special and unique requirements. EML conducts authoritative and unbiased reviews and evaluations of proposals and provides expert consultation and programmatic support for the Office of Science (SC) and the Office of Defense Nuclear Nonproliferation (NN).

WFO (WORK FOR OTHERS)

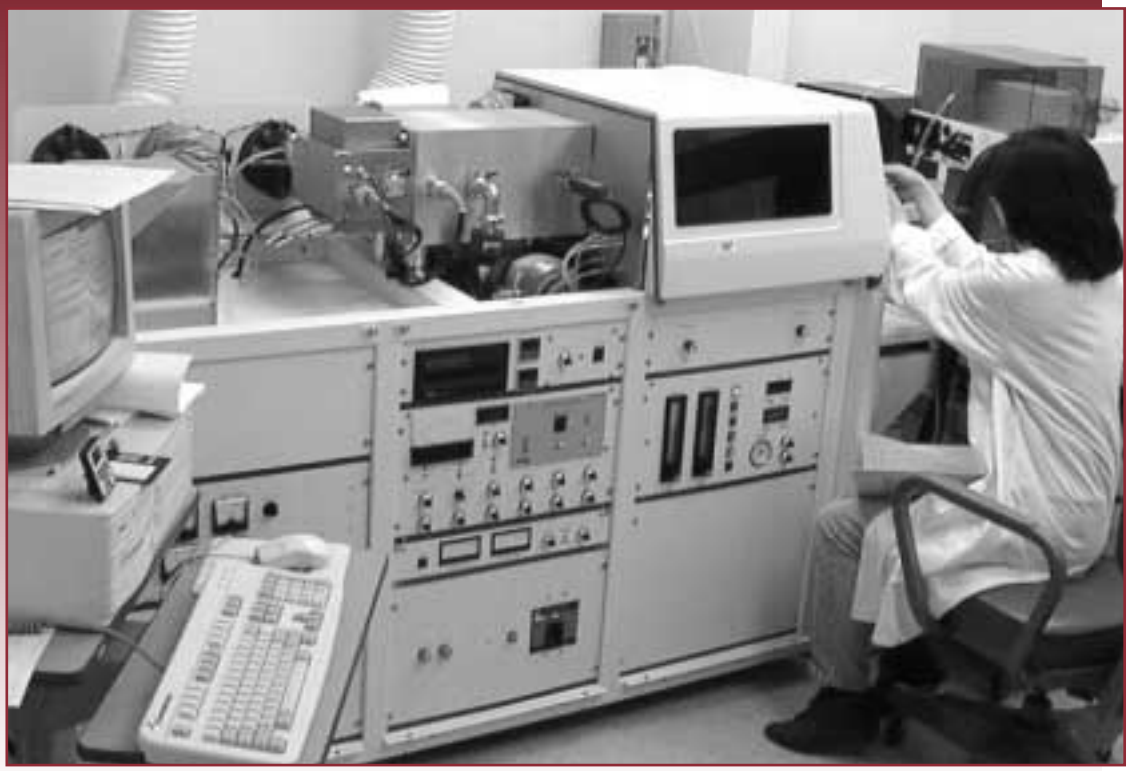
EML's longstanding reputation for excellence in environmental measurements has led to its being called upon for assistance and consultation by numerous organizations in the United States and around the world. The Laboratory fulfills special needs within the scientific community outside of DOE that relate to the assessment of radiation and radioactivity in the environment. Projects of this nature are a natural extension of the staff's collective expertise and are in keeping with a larger role that a specialized laboratory such as EML plays within the DOE family. EML's WFO customers include the Air Force (AF), the Nuclear Regulatory Commission (NRC), the Defense Threat Reduction Agency (DTRA), Army Corps of Engineers, and the Environmental Protection Agency (EPA) who gain from the Laboratory's unique strengths.



EML's funding in FY 2000 by sponsoring agency

Environmental Quality

EML develops and implements quality assurance (QA) methodology and programs to meet the needs of its DOE customers; to assess, track, evaluate and improve the nationwide performance of the Department's contractors for environmental analytical services; and to assist in site closure activities by providing expertise in assessments of radioactive contaminants and the associated dose to people.



ICP/MS used for the Quality Assessment Program methods development.

QUALITY ASSESSMENT PROGRAM (QAP)

EM

EML's QAP is an external, independent performance-based evaluation program designed to test the quality of environmental radiological measurements reported by DOE contractor and subcontractor laboratories.

The semi-annual program provides EM with complex-wide comparability of environmental radiological analyses for characterization, site survey and monitoring activities. Participation of EM contractors is required by DOE Secretarial Memorandum (March 1993).

For each QAP shipment, EML processes in house: 100 L of water and 300 filters spiked with a cocktail of known alpha, beta, and gamma emitters; 25 kg of blank vegetation and 40 kg of blank soil each spiked with a naturally contaminated material; and gross alpha-and beta-spiked filters and water.

Every radionuclide for each of these materials is analyzed twice at EML using two different analytical methods. Aliquots from these filter, water and soil samples are then distributed to the participating national and international laboratories, which numbered 172 in FY 2000. Analytical results are then reported to EML, and a summary evaluation is available via the EML Web Site to the participants 48 hours after the reporting deadline.

The final QAP results are issued as EML Reports in December and June and are also available on EML's Web Site. As part of the QAP, EML provides quality control materials for corrective actions, methods evaluation and batch control as requested by the participating laboratories. (Raymond.Bath@eml.doe.gov)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) TRACEABILITY

EM

EML continues to serve as a Reference Laboratory for the DOE Radiological Traceability Program (RTP). The National Analytical Management Program (NAMP) established the RTP to support EM's need for high quality data from DOE radioanalytical contractor laboratories. EML's status as a Reference Laboratory establishes that EML's QAP performance evaluation materials are directly traceable to NIST, the U.S. national standard for radioanalytical measurements. (Stacey.Loyland@eml.doe.gov)

Sample analysis in one of EML's chemistry laboratories.

GAMMA SPECTROMETRY DATA EVALUATION PROGRAM

EM

The EML Gamma Spectrometry Data Evaluation Program is designed to assess the capabilities of DOE laboratories and contractors in the performance of both routine and more complicated gamma spectrometry analyses. EML administers the Program as part of DOE's Quality Assessment Program Services in support of EM-5.

This voluntary program tests both the gamma spectrometry software and the ability of the laboratory to properly use the software by sending synthetic gamma spectra to participants for analysis. The objective is to be an aid to participants by providing analysis problems that are difficult to create with spiked samples due to the unavailability of many nuclides and the short half-lives of others.

Thirty-one U. S. and foreign laboratories sent in their results for the third distribution of the EML Gamma Spectrometry Data Evaluation Program. Laboratories from Slovenia, Syria, Hungary and Argentina participated for the first time. (Karin.Decker@eml.doe.gov)

EML's gamma spectrometry laboratory.

SITE ASSISTANCE

FEMP — Dose Calculations of Atmospheric Aerosols

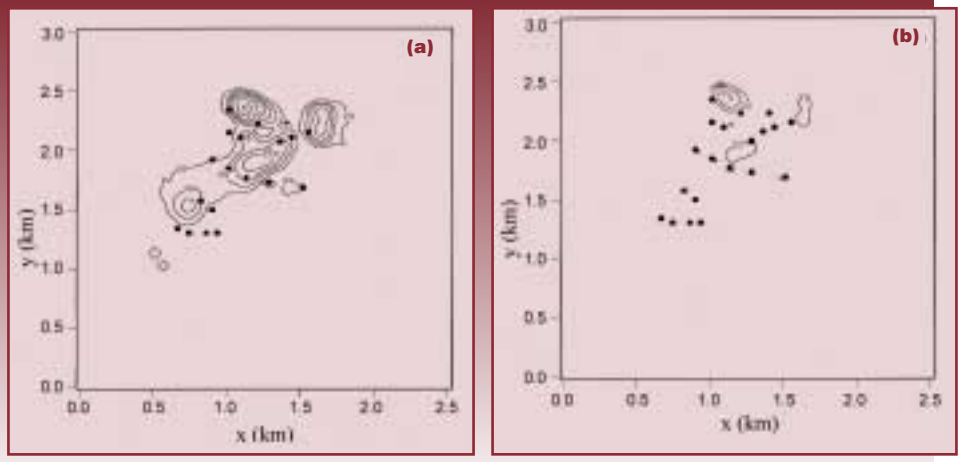
EM

Continuing EML's study of Fernald Environmental Management Project (FEMP) aerosols using a rotating drum impactor co-located with a high volume air sampler allowed us to calculate improved dose measurements to the population. We used our data on the size distribution of uranium bearing atmospheric aerosols to compute the dose using several different models. The current method used to calculate the dose and demonstrate compliance with EPA regulations assumes a single particle size. This assumption results in an overestimate of the dose to the populations offsite by as much as a factor of seven relative to values derived using the latest International Commission on Radiation Protection (ICRP) 66 lung model with more appropriate particle sizes. In FY 2001, EML will shift its emphasis from uranium to thorium because of FEMP site activity changes. (Robert.Leifer@eml.doe.gov)

FEMP — Groundwater Modeling

EM

EML applied its state-of-the-art three-dimensional groundwater model to examine the transport of subsurface uranium contamination at Fernald, Ohio, for the FEMP. Modeling different scenarios showed that adding the chemisorption process resulted in the immobilization of the uranium plume with significant volume reduction. Future activities include verifying, through laboratory experiments, the importance of chemisorption in controlling the uranium contamination in the groundwater and in predicting the cleanup time needed for remediation at FEMP. (Sam.Lee@eml.doe.gov)



Model simulations of uranium concentrations (in units of ppb) at FEMP: **(a)** without chemisorption, and **(b)** with chemisorption. (Dots denote the wells.)

BNL — Environmental Radiation and Radioactivity

EM

EML is using its expertise in environmental radiation and radioactivity to assist in remediation efforts taking place at Brookhaven National Laboratory (BNL). In FY 2000, we continued our quarterly TLD monitoring of the Building 650 Sump Outfall Area to provide regulators with assurance that there has been no contaminant movement. This interim monitoring will continue for the next year or two until the area undergoes cleanup.

We also prepared information on regional background levels of natural and anthropogenic radionuclides to provide a needed perspective in achieving compliance with final remediation levels in various operable units at the site.

In addition, as a follow-up to our QA work for the BNL Peconic River study, we provided review and comments on the draft report dealing with the plutonium contamination characterization and radiological dose and risk assessment. (Kevin.Miller@eml.doe.gov)

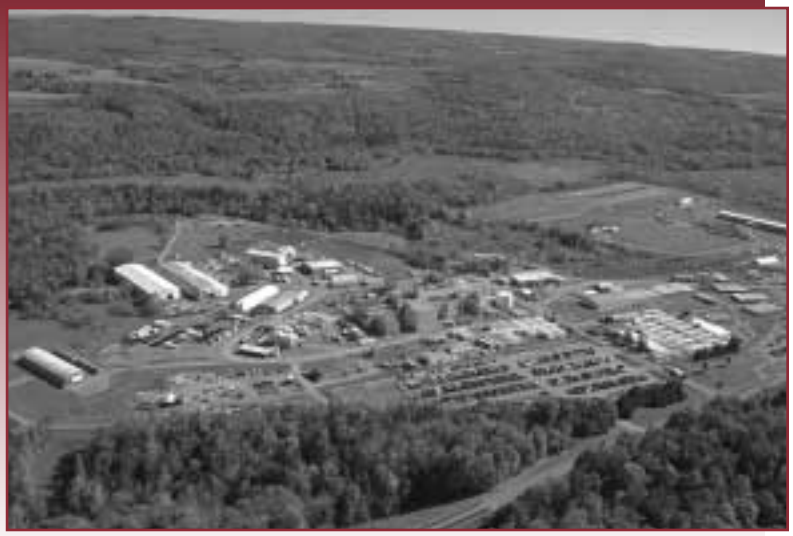
External radiation levels are monitored at the BNL Building 650 Sump Outfall Area using pole-mounted TLDs set out in an array of 21 stations. Three years of data have been collected that has provided assurance that no significant contaminant movement has taken place.

WVDP — West Valley Demonstration Project

EM

The Draft Environmental Impact Statement for the completion of the WVDP and closure and/or long-term management of facilities at the Western New York Nuclear Service Center divided the site into Waste Management Areas (WMAs), and for each WMA, presented the impacts associated with five potential closure alternatives.

In FY 2000, EML focused on evaluating WMA 3 (the High-Level Waste Storage Area - Tanks 8D-1 and 8D-2, the Vitrification Facility and other facilities), and closure Alternative I (the complete removal of all structures, systems and components and the release of the area for unrestricted use). The results and findings of EML's re-estimation of the impacts associated with the complete removal of the HLW tanks and surrounding facilities were published in an EML Report. (Kevin.Miller@eml.doe.gov)



West Valley Demonstration Project site.

ADVANCED SURVEY METHODS FOR THE CLEARANCE OF SOLID MATERIALS

NRC

The NRC has contracted with EML to provide assistance in several areas relating to characterization issues for NRC licensees. In FY 2000, EML authored a report detailing the state of the art for advanced radiation detection instrumentation that can measure and quantify small amounts of radioactivity in solid materials (metals, concrete, rubble and soil).

EML is also developing a statistically based survey protocol, including appropriate analytical techniques, for determining activity concentrations and inventories that are near, at, or below background levels for various source geometries and matrices. This work has included: 2-D double-sampling (pre-survey design of multi-stage re-sampling); a transition from 2-D Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) surface sampling to 3-D subsurface sampling; and the development and validation of sampling protocols and statistical analyses for materials clearance.

Finally, EML is preparing a feasibility study to establish criteria that validate the use of previous survey data in final status surveys as well as an audit capability for final status survey results. (Carl.Gogolak@eml.doe.gov)

IN SITU GAMMA-RAY SPECTROMETRY INTERCOMPARISON

EM

EML, in conjunction with the EPA's Office of Radiation and Indoor Air, staged an intercomparison for seven different groups that practice and/or develop systems related to *in situ* gamma-ray spectrometry. The intercomparison was held at the Walker Field Large-Area Calibration Pads in Grand Junction, CO, in FY 2000. These pads consist of thick concrete slabs with enhanced levels of ^{226}Ra, ^{232}Th and ^{40}K, and represent the only well-characterized large area radioactive sources in the United States.

EML plans to continue holding intercomparisons such as this because they serve as important performance checks for users, improving the overall quality of *in situ* gamma-ray measurements while also helping to promote its acceptance. (Peter.Shebell@eml.doe.gov)

Walker Field pads in Grand Junction, Colorado, site of the Intercomparison of High Purity Germanium Detectors for *In Situ* Spectrometry.

CENTER FOR RISK EXCELLENCE (CRE) — EM

EML is coordinating the CRE's effort to manage, refine and update the Cleanup Criteria database. EM established this Internet accessible database to record agreed upon values of cleanup criteria. The database includes more than 50 data elements such as cleanup concentration, response strategy, projected and actual costs, and land use for 320 DOE remediation sites. Data are drawn from regulatory compliance documents such as Records of Decision and internal DOE reports.

EML worked with EM Headquarters and Argonne National Laboratory to review the data and input additional information. In FY 2000, EML developed concise fact sheets for key contaminants in order to facilitate the use of database information by field managers. EML also authored a paper on cleanup criteria for publication in a peer reviewed science and policy journal, and performed analyses of the data for a conference presentation and a subsequent journal publication.

For FY 2001, EML will update the analyses for key contaminants, including input from 29 new decision documents covering 98 additional subsites. We will also investigate cost data to address EM issues of budget shortfalls. By providing the field with a means of comparing cleanup criteria for individual contaminants across the DOE complex, the database can be a useful tool for future cleanup decisions. (Gladys.Klemic@eml.doe.gov)

THERMOLUMINESCENCE DOSIMETRY (TLD) INTERCOMPARISON — EM, NN

TLD intercomparison organizers at the field deployment site.

EML, in collaboration with BNL, NIST and the International Atomic Energy Agency (IAEA), conducted the 12th International Intercomparison of Environmental Dosimeters in FY 2000. The Intercomparison was held at EML's Field Performance Testing Area at BNL, and included 131 participants from 40 countries.

With a total of over 2,000 dosimeters tested under field or laboratory conditions, this 12th intercomparison was more extensive than all previous intercomparisons conducted.

During FY 2000, we completed the field and irradiation phase of the intercomparison. The project will come to a conclusion in FY 2001 when the results will be published and presented in scientific forums, as has been done for previous intercomparisons. (Matthew.Monetti@eml.doe.gov)

DOSE ESTIMATION METHODS — EM

Environmental remediation work projects are guided by dose criteria derived from what are or should be relevant and up-to-date dose estimation procedures. In many cases, methods and parameter values are entered into the computer codes without provision for continued review and update as new and improved data become available on transport processes, environmental and metabolic behavior, and doses per unit intake of radionuclides. In FY 2000, EML staff began reviewing current environmental remediation practices.

Based on this review, EML will then be able to provide advice to sites on selecting credible exposure scenarios, utilizing realistic dose estimation parameters and methods, and accounting for variabilities and uncertainties so that dose criteria will be soundly based, reasonable, and acceptable to all concerned. (Burton.Bennett@eml.doe.gov)

LOS ALAMOS PUEBLO PROJECT — EM, DP

The Los Alamos Pueblo Project (LAPP), jointly sponsored by Defense Programs (DP) and EM, funds environmental studies programs that will help the Pueblos determine if there are impacts to their resources due to the operations at LANL. The LAPP is designed to help the Pueblos obtain results that are scientifically sound and technically defensible, and to provide assistance in developing a scientifically based environmental infrastructure. Advisory Review Teams are assembled to review the progress of Pueblo environmental programs. These teams are comprised of experts in soil, sediments, surface and groundwater monitoring, and the quality assurance and design and management of environmental monitoring programs.

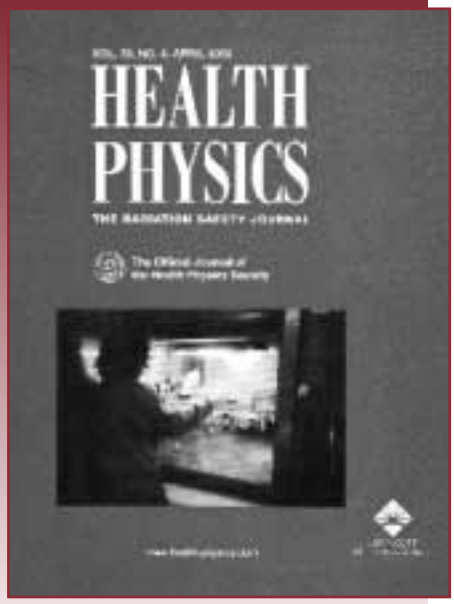
In FY 2000, EML participated, by invitation, on four Advisory Review Teams. In addition, EML through the Center for Risk Excellence provided training for the course "Fundamentals of Human Health and Ecological Risk Assessment for Environmental Monitoring and Protection."
(Catherine.Klusek@eml.doe.gov)

INFRASTRUCTURE/LABORATORY MANAGEMENT

EM

The OST is now the Cognizant Secretarial Office (CSO) for all EM Laboratories (Idaho National Energy and Environmental Laboratory (INEEL), the Savannah River Technology Center (SRTC), the Radiological and Environmental Sciences Laboratory (RESL), and EML), and has established a Laboratory Management group to supervise these organizations. In order to ensure that the EML/OST partnership is as productive as possible, an EML scientist has served on detail at EM Headquarters in Washington, D.C. over the past year. This has helped to provide OST with an understanding of EML's capabilities, and has enabled EML to respond rapidly and efficiently to opportunities and needs within EM.

In addition, as part of this detail the question of infrastructure status and requirements at all designated EM laboratories has been examined. Based on site visits and on discussions with responsible officials at these laboratories and at EM Headquarters, a report has been prepared and submitted to the OST Deputy Assistant Secretary. (Alfred.Cavallo@eml.doe.gov)



EML scientist on the cover of the Health Physics Journal assembling dosimeters in an environmental chamber for a pilot test of ANSI Draft N13.29.

STANDARDS DEVELOPMENT

ANSI-N13.37: American National Standard for Environmental TLDs.

EM, NN

Since 1998, EML has chaired the American National Standards Institute (ANSI) Standard N13.37 committee that develops procedures for using TLDs in environmental applications.

Environmental TLDs are stationed at the fence line and in communities near nuclear power plants, research facilities, interim waste storage areas, and remediation sites as part of environmental surveillance programs that assess the radiation dose to the public. N13.37 is directed to the users and processors of TLDs and will replace ANSI-N545, which has served as the United States guidance since 1975. The N13.37 committee includes experts from DOE, NRC, NIST, academia, and industry.

In FY 2000, a new revision was developed as part of the goal of completing the standard in FY 2001. (Gladys.Klemic@eml.doe.gov)

ANSI N42.28: In Situ Gamma-Ray Spectrometry

EM

EML is a member of the ANSI N42.rm subcommittee that develops standards, usually performance standards, for radiation detection instrumentation. EML also co-chairs with INEEL a writing group working on ANSI N42.28, "Performance Standard for the Calibration of Germanium Detectors for *In Situ* Gamma-Ray Measurements." (Peter.Shebell@eml.doe.gov)

MULTI-AGENCY RADIOLOGICAL LABORATORY ANALYTICAL PROTOCOLS (MARLAP)

EM

The MARLAP manual addresses the need for a nationally consistent approach to producing radioanalytical laboratory data that meets a project or program's data requirements. The MARLAP manual provides guidance for the planning, implementation, and assessment phases of those projects requiring laboratory analysis of radionuclides. MARLAP is a multi-agency effort including the EPA, DOE, Department of Defense (DoD), NIST, US Geological Survey (USGS), Food & Drug Administration (FDA), and two state representatives (KY and CA).

EML, in support of EM-5, provided a lead technical role in the development of the manual by writing several of the chapters and participating in multi-agency consensus of the draft document. The manual was released for government review in FY 2000. EML assisted the MARLAP government review process by developing a secure Web Site for reading the manual, and for storing, tracking and categorizing the comments received.

MARLAP is in the final stages of government review and will be released for public comment in FY 2001, prior to final release. (Catherine.Klusek@eml.doe.gov)

National Security

As a federal facility, EML supports DOE's National Security mission through its detection and deterrence activities for the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and the Nonproliferation Treaty (NPT). EML has been designated to be the "U.S. Radionuclide Laboratory" for the CTBT. In addition, EML's archive of more than 50,000 environmental samples, many dating back to more than 40 years ago, can be used for geo-location in forensic nuclear analyses, for identification of environmental signatures of nuclear activities, and for the establishment of current baseline values for selected environmental signatures.

EML's CTBT radionuclide laboratory.

CTBT RADIONUCLIDE LABORATORY

DTRA

EML is establishing a dedicated radionuclide laboratory, within its current facility, in accordance with the requirements of the Provisional Technical Secretariat of the CTBT Organization. EML provides staff and technical expertise for the analysis of air filters by gamma-ray spectrometry. EML will be prepared to perform other radiochemical measurements in support of the Treaty if requested. In FY 2000, EML purchased and calibrated two high efficiency and high-resolution gamma-ray spectrometry systems for dedicated use in the CTBT Radionuclide Laboratory at EML. EML is developing procedures for the analysis, tracking, QA, and reporting of sample data to the CTBT Organization. A VSAT communication system was installed at EML for secure communications with the CTBT Organization. EML also provides technical review and comments for the working group on radioanalytical issues. (Colin.Sanderson@eml.doe.gov)

CTBT CERTIFICATION

DTRA

Radionuclide laboratories that support the International Monitoring System (IMS) for verification of the CTBT are required to be certified by the Technical Secretariat. In preparation for certification later this year, EML has drafted a Quality System Manual, a Quality Management Plan, a Quality Assurance Project Plan and over 20 Standard Operating Procedures. A certification requirement is that these documents must be reviewed, approved and put into practice. The purpose of certification is to confirm that the quality and the efficiency of verification activities with regard to IMS sample analysis at laboratories are guaranteed. The intent is to provide the States Signatories and the Treaty Preparatory Commission with confidence in the laboratory aspect of the verification regime. (Colin.Sanderson@eml.doe.gov)

INTERNATIONAL ENVIRONMENTAL SAMPLE ARCHIVE (IESA) NN

EML is developing the IESA, which is an Internet accessible database containing information on environmental samples (air, water, soil, sediment, vegetation, etc.) that are archived by national and international organizations. The database can be used to identify the availability of historic environmental samples at any location in the world. Many of these historic samples, collected during the period of atmospheric nuclear weapons testing, have unique isotopic compositions.

IESA database map search interface
(available at: http://nesa.eml.doe.gov)

IESA currently includes many of the over 2 million samples in the U.S. Geological Survey's archive, over 50,000 samples in the EML archive, 900 soil samples archived by the Remote Sensing Laboratory and 2,500 air filter samples collected by the Naval Research Laboratory.

A graphical map search interface to the database facilitates "ease of use" allowing the user to find data quickly and efficiently.

The database can be accessed at http://nesa.eml.doe.gov/. (Richard.Larsen@eml.doe.gov)

GLOBAL ATMOSPHERE WATCH (GAW) NN

The World Meteorological Organization's GAW Program has designated EML as the World Calibration Center for Radioactivity responsible for radionuclide air sampling and calibration worldwide at GAW sites. GAW is a coordinated network of observation stations and related facilities whose purpose and long-term goal is to provide data, scientific assessments, and other information on global changes in the chemical composition and related physical characteristics of the atmosphere.

In cooperation with the GAW, EML may establish a global air sampling station in China and at other locations where coverage is needed. (Sam.Lee@eml.doe.gov)

EML's Global Network site at Cape Point, South Africa

EML's GLOBAL NETWORKS NN

EML maintains a worldwide network of aerosol and deposition sampling stations to document spatial and temporal trends in the distribution of artificial and naturally produced radionuclides in the atmosphere and to rapidly identify any new sources of activity such as an accidental release. Data from remote on-site analysis systems are received via satellite. Samples are received, analyzed and reviewed at EML.

EML's Global Network has been a cornerstone in monitoring compliance to treaties and in acting as an early warning system for nuclear releases. (Colin.Sanderson@eml.doe.gov)

RADIATION DETECTION PANEL (RDP) NN

EML is a member of the RDP, which is a standing advisory group composed of technical experts in radiation detection from DOE laboratories. The RDP supports NN in its responsibilities for treaty monitoring, Presidential Decision Directives, and DOE, DoD and other agencies by providing timely expert advice as requested. The RDP convened twice in FY 2000 and will meet at least twice in FY 2001 for program reviews and technology symposia. (Paul.Goldhagen@eml.doe.gov)

Science & Technology

EML supports EM cleanup and closure activities at DOE sites by developing, demonstrating and deploying advanced radiological measurement and survey methods and instruments; by assisting in the collection, interpretation, and modeling of radioactive contaminant data in special low level (at or near background) situations; and by insuring the overall quality, cost effectiveness and industry acceptance of field radiation measurement technology.

EML staff, as federal technical experts, continue to support EM and SC Headquarters by fulfilling not only administrative roles, but more importantly, technical direction for several programs. EML maintains and provides access to the DOE Human Subjects Research Database (HSRD) through the Internet for SC.

The technical expertise at EML is also utilized through staff participation on several advisory committees and working groups that help the Department maintain its high quality research and relevance in the areas of environmental radiation and radioactivity measurement and detection.

CESIUM 2K ANALYZER

EM

EML has completed the development and construction of a portable, field grade Cesium 2k Analyzer that measures ^{137}Cs collected on 3M™ Empore Rad disks from water samples. This EML designed instrument can be built for less than $2,000, which is less than one-fifth the cost of commercially available and non-portable instruments. This unit is ideally suited for use in deactivation and decommissioning (D&D) operations, site cleanup, monitoring cooling ponds, and other operations where ^{137}Cs might be present in aqueous solutions.

The EML Cesium 2k Analyzer offers the ability to quickly get results in the field, thus saving time while also providing critical data to determine where and if additional samples should be taken. In FY 2001, the unit will be field tested at the Savannah River Site, R-Basin. (Norman.Latner@eml.doe.gov)

EML's Cesium 2k Analyzer
for ^{137}Cs determination in water samples

PADUCAH GASEOUS DIFFUSION PLANT (PGDP) RADIONUCLIDE IN BONE STUDY

EM

Previous workers and/or the families of deceased workers of the PGDP have filed several lawsuits against DOE and its former contractors. In one such case, by request, EML methods were used for the preparation of exhumed femurs for subsequent analysis of uranium, plutonium, americium and neptunium, also including chain of custody protocols, sample handling and storage, and the evaluation of the samples prior to preparation. EML also provided quality control samples from the EML Bone Inventory. Upon completion of the preparation work at EML, the samples were shipped to a program consultant for subsequent analyses at an analytical laboratory to be determined. (Isabel.Fisenne@eml.doe.gov)

EML/NIST AMERICIUM ALPHA SPECTRAL ANALYSIS STUDY

EM

There is a growing need at many DOE sites to determine ^{241}Am in low-level environmental samples. However, when using alpha spectrometry to measure the ratio of ^{243}Am (added as a tracer) to ^{241}Am, the overlap of the ^{241}Am peak with the ^{243}Am peak needs to be resolved accurately for the data to be reliable. In FY 2000, EML, in collaboration with NIST, evaluated the performance of five different deconvolution techniques for the analysis of alpha spectra of samples with known ^{241}Am/^{243}Am ratios. Preliminary results show that all of the techniques tested were sensitive to peak shape and displayed some degree of inconsistency.

An additional study is planned in FY 2001 to evaluate the performance of each technique using samples with excess ^{243}Am, which would result in spectra with minimized overlap. (Anna.Berne@eml.doe.gov)

NEW AUTORAMP DEVELOPMENTS

EM

In FY 2000, EML developed adaptations to the EML-designed and constructed AUTORAMP to enable alpha measurements. At some DOE facilities alpha measurements of airborne radioactive contaminants may be more sensitive than gamma-ray analysis, especially where the contaminants of concern are depleted uranium or plutonium since the long-lived isotopes of both of these elements decay primarily with alpha emissions. Because of the cartridge geometry in EML's AUTORAMP, the only compatible alpha analysis involves the measurement of the ionization produced by an alpha particle as its energy is absorbed in air.

Although this type of alpha measurement has been done before, the associated technology is difficult and requires careful consideration of the low frequency noise inherently present with this method.

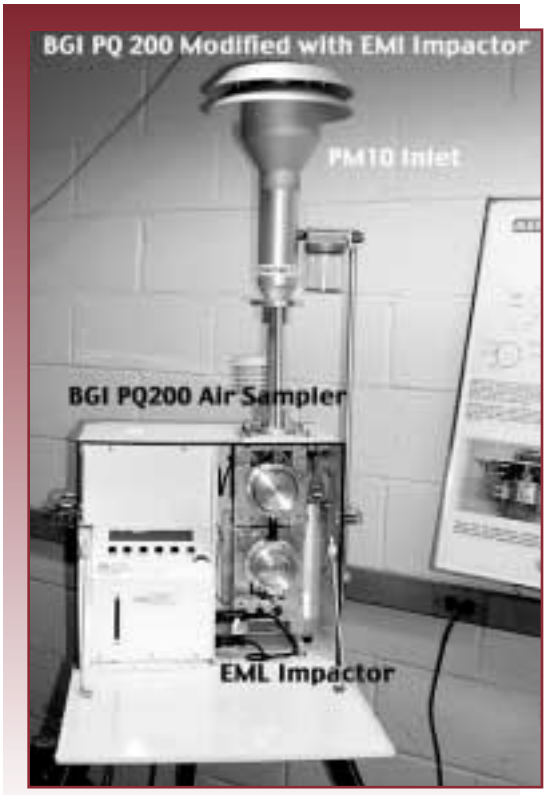
To obtain a better understanding of this low frequency noise, spectral analysis techniques using the Fast Fourier Transform (FFT) and swept-frequency spectrum analyzers were used to study the frequency characteristics of this noise. The results of this low frequency noise study have been used to help design the pulse ionization chamber that accommodates the AUTORAMP filter cartridge. EML completed construction of this alpha chamber and will evaluate its performance in FY 2001. (Vincent.Negro@eml.doe.gov)

ADAPTING EML'S AEROSOL SAMPLER TO A COMMERCIALLY AVAILABLE INSTRUMENT

EM

EML's two-stage rotating drum parallel impactors were retrofitted with a commercially available EPA approved reference filter sampler. The resulting instrument will be able to measure radionuclide concentrations in remote regions where a solar/fuel cell combination can allow unattended operation for extended periods.

A model PQ200 filter sampler, on loan from BGI, Inc. (Waltham, MA), needed significant modifications as EML's impactor requires more demanding flow rates and circuits to control the stepping rate. The sampler is under evaluation and will be field tested in FY 2001, and compared with other atmospheric samplers at the University of California, Davis. (Robert.Leifer@eml.doe.gov).



EML's aerosol sampler
integrated with reference filter sampler.

LARGE 1-INCH DIAMETER GERMANIUM WELL DETECTOR EM

In FY 2000 EML evaluated the applicability of a state-of-the-art large "well" type germanium detector for use in the CTBT program and to develop procedures for its use in the EML QAP. Minimum detectable activities for radioxenons of interest in CTBT were calculated from the experimental data developed on detector counting efficiency vs. gamma-ray energy. For QAP, several procedures were developed for improved determination of americium. (Raymond.Lagomarsino@eml.doe.gov)

NEUTRON SPECTROMETRY EM

The EML multisphere neutron spectrometer (MNS) was the primary instrument used in the Atmospheric Ionizing Radiation (AIR) Measurements Project to determine doses from cosmic radiation, especially neutrons, to occupants of high-altitude aircraft. The AIR Project was an international collaboration of 15 laboratories that placed 14 instruments on multiple flights of a NASA ER-2 high-altitude aircraft.

In FY 2000, the response of the EML MNS was recalculated using the Los Alamos high-energy radiation transport code MCNPX. Cosmic-ray neutron spectra and effective dose rates were determined for a wide range of altitudes and latitudes. The EML spectral deconvolution code, MAXED, developed for this study is now being adopted by neutron spectrometrists around the world. The EML results can be applied to improve radiation dosimetry at accelerators, plutonium-handling facilities, and wherever there is neutron radiation with an unusual or unknown energy spectrum. (Paul.Goldhagen@eml.doe.gov)

HUMAN SUBJECTS RESEARCH DATABASE (HSRD) SC

EML maintains the HSRD for the Life Sciences Division in SC. The database, a component of the Protecting Human Subjects Program, documents all research involving the use of human subjects that is funded by DOE, occurs at DOE facilities or is performed by DOE personnel. Researchers of projects that involve human subjects must contribute to the database as required by DOE O 443.1 Protection of Human Subjects. EML is responsible for creating, annually updating, maintaining and ensuring the quality of the database. EML also provides software development and participates in the Human Subjects Working Group. This year, the FY 1999 database was updated and can be accessed from EML's Web Site. EML is currently gathering and reviewing information for the FY 2000 database.

Also in FY 2000, EML participated in field audits, conferences, publications, telemeetings, and coordinating the activities of the Human Subjects Working Group. (Richard.Larsen@eml.doe.gov)

Members of the Human Subjects working group exchanging information.

IN SITU GAMMA-RAY SPECTROMETRY

EM

EML provides consultation to DOE and contractor staff on low-level radiation measurements to support cleanup efforts at various sites in the DOE complex. In particular, EML is recognized for its expertise in *in situ* gamma-ray spectrometry, a real-time measurement method that can provide nuclide-specific concentrations of residual radioactivity in soil and other materials. In FY 2000, EML was involved with several projects relating to this technology.

FEMP-ASTD EML, along with staff from ANL and INEEL, was part of a team effort at FEMP under the Accelerated Site Technology Deployment (ASTD) program in supporting the use of real-time spectrometry systems for measurements of uranium, thorium and radium in soils. Large areas of land outside the production area at FEMP have now been certified as meeting final remediation levels. Cost savings so far have totaled about $15 million using this technique in place of baseline sampling and laboratory analysis.

EM

EML continues to provide technical reviews of reports, data interpretation, calibration assistance and QA, and performs specialized studies to support the real-time measurements program at FEMP. Additional cost savings over the next five years using this measurement technique are expected to be about $19 million. (Kevin.Miller@eml.doe.gov)

BNL-ASTD EML and BNL are involved in an ASTD project at BNL for applying *in situ* spectrometric methods and survey design methodology based on MARSSIM principles. This effort was directed toward the radiological characterization of components to support the decontamination and decommissioning of the Brookhaven Graphite Research Reactor. We participated in survey planning meetings with regulators, assisted in developing sampling designs and reviewed measurement data. EML will continue to support BNL in this and other applications of cost-effective radiological survey methodology for their environmental restoration programs. (Kevin.Miller@eml.doe.gov)

EM

***In Situ* Gamma-Ray Spectrometry Advances** EML has pioneered the development of deconvolution methodology for interpreting closely spaced field spectrometric measurements. This approach can provide a better estimate of soil contamination patterns as compared to simple data interpolation methods. In FY 2000, the deconvolution code was modified to incorporate radial basis functions to treat the data. This method allows realistic smoothed radionuclide concentration patterns to be generated. This added feature to our previously developed "hot spot" mapping code provides a result that is useful for guiding soil excavation work for remediation. (Paul.Bailey@eml.doe.gov)

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Spectrometer attached to the INEEL Excavator Mounted System during a demonstration trench measurement at FEMP. EML is providing the technical basis to support these types of measurements in the former FEMP production area where excavations will produce geometries that depart from the normal flat ground measurements traditionally associated with *in situ* gamma-ray spectrometry.

Strategic Environmental Research and Development Program (SERDP) SC

EML continued its role as SERDP Technical Coordinator for all Departmental activities for DOE Offices (SC, EM, DP, NNSA, FE, and others) and the National Laboratories with the DoD, EPA and other federal agencies partnering with SERDP. FY 2000 activities included developing the statements of needs related to the DOE/DoD mission for projects to be funded by SERDP, providing guidance for the fiscal year program, reviewing and selecting proposals, and reviewing SERDP new-start and continuing research projects. In addition, EML also participates as an EM representative on the "Compliance" Technical Thrust Area Working Group. (Merrill.Heit@eml.doe.gov)

Participants of the 10th Annual Meeting of the JCCEM

Joint Coordinating Committee for Environmental Restoration and Waste Management (JCCEM) EM

The JCCEM is the managing body of a Memorandum of Cooperation between EM/OST and the Russian Ministry of Atomic Energy (MINATOM), operating under the umbrella of the Peaceful Uses of Atomic Energy Act.

For several years, EML has functioned as the Technical Program Manager (TPM) for the Site Characterization and Contaminant Transport area of cooperation, which aims to develop a mutually beneficial program utilizing Russian data and expertise of groundwater contaminant transport at the Mayak, Tomsk, and Kransnoyarsk Russian nuclear sites. The TPM ensures that the technical direction of the program is beneficial to EM site cleanup activities, and is responsible for the planning and coordination of the projects.

Collaborative American/Russian studies are on-going with scientists from the Pacific Northwest National Laboratory, Hydrospetzgeologiya, the Institute of Physics and Power Engineering, the All Russian Scientific Research and Exploratory Planning Institute of Industrial Technology (VNIPIPT), the Mayak Production Association, and the Siberian Chemical Combine (Tomsk-7).

During FY 2000, major activities for the TPM included strategically planning the closing-out of studies at Mayak and the restart of Tomsk projects. (Adam.Hutter@eml.doe.gov)

National Science Foundation publication containing article **"Department of Energy's Arctic Research"** authored by an EML scientist.

Interagency Arctic Research Policy Committee (IARPC) EM

EML continued to provide staff representation for DOE at all IARPC meeting to ensure coordination of Arctic research activities with other federal agencies. In addition, the EML staff representative prepared all required IARPC-related reports for the Department, including the "Biennial Update of the Arctic Research Plan," the "Annual Overview of Agency (DOE) Arctic Research," and responses to programmatic questions from the Arctic Research Commission (ARC). EML also serves as a member of the IARPC-related multi-agency Working Group on the "Study of Environmental Arctic Change. (Merrill.Heit@eml.doe.gov)

Characterization, Monitoring and Sensor Technology Cross-Cutting Program (CMST-CP) EM

The CMST-CP provides innovative technologies as part of OST's responsibility for providing a full range of science and technology resources needed to support resolution of EM cleanup and long-term environmental stewardship problems. EML plays an integral role in CMST-CP's implementation, management and planning of its R&D activities. In FY 2000, EML continued as CMST-CP's liaison to the Deactivation and Decommissioning Focus Area (DDFA) and as project facilitators.

As project facilitators, EML's scientific staff provides technical evaluation of proposals and technologies, as well as monitoring project development. The Liaison to the DDFA is part of the Field Technical Management Team interacting with the EM/OST Focus Areas and providing guidance to the program, such as helping to produce CMST-CP's technology roadmap. (Adam.Hutter@eml.doe.gov)

THE U. S. TRANSURANIUM AND URANIUM REGISTRIES (USTUR) ADVISORY COMMITTEE EM

The USTUR were established to perform measurements on former actinide orkers to verify the mathematical models used to estimate radiation doses from inhalation, ingestion and wound exposures. The information gathered by the USTUR has been folded into the radiation dose estimates of the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP). The Advisory Committee to the USTUR provides an independent review of the work in progress and envisioned.

The Committee consists of seven members: one from Washington State University, the location of USTUR; one from the general public; one from organized labor; and the remaining members are selected from the scientific community with expertise in health physics, radiochemistry, radiobiology and bioethics. EML has participated for three years on the Committee in the dual role of radiochemistry expert and DOE representative to the Committee, and has accepted an additional three-year appointment. (Isabel.Fisenne@eml.doe.gov)

GULF WAR DEPLETED URANIUM ISSUES DoD

At the request of the DoD Special Assistant for Gulf War Illness, EML participated in a critical review of the document "Environmental Exposure Report, Depleted Uranium in the Gulf." The draft report incorporated a discussion of the use of depleted uranium (DU) in the Gulf War, several exposure scenarios, background summaries of previous work directed to determining the aerosol particle size under simulated battlefield conditions, and the estimation of the external and internal radiation doses for various exposure situations.

Also in FY 2000, the DoD organized an intercomparison study for the measurement of DU in urine. EML was requested to participate based on the DU urinalyses performed at EML on samples obtained from actual Gulf War veteran wound cases or potential inhalation cases. The synthetic urine samples were received, separated and measured for isotopic uranium by solid-state alpha spectrometry and the results reported. The preliminary results from the participating laboratories are being tabulated. (Isabel.Fisenne@eml.doe.gov)

Guests at EML

As always, during the past year EML received a great many official visitors from all corners of the world, some for just a day or two, others for extended periods as Visiting Scientists. We encourage members of the scientific community, our sponsors, and other interested parties to visit EML. (Rita.Rosen@eml.doe.gov)

Visit to EML by DOE Headquarters and Operation Office Managers.
Left to right: Robert San Martin (Manager, Chicago Operations Office), Gerald Boyd (Deputy Assistant Secretary, OST), Mitchell D. Erickson (Director, EML), Carolyn Huntoon (Assistant Secretary for EM), Catherine Klusek (Deputy Director, EML), Merrill Heit (Technical Assistant to EML Director).

General Eugene Habiger, Director of DOE's Office of Security and Emergency Operations, presenting EML's Camille Marinetti with his "coin" of approval for her quality efforts in Cyber Security during his visit to the Laboratory in FY 2000.

Workshop of the MARLAP Manual Working Group

An EML Chemist (right) and Visiting Scientist Svetlana Bouzdalkina (left) from The Institute of Radiology in Belarus during her three month IAEA-sponsored fellowship at EML to study radiochemistry procedures and methods.

Publications & Patents

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Mitchell D. Erickson, Director
Phone: (212) 620-3619
FAX: (212) 620-3651
e-mail: mitchell.erickson@eml.doe.gov

EML Web Page: http://www.eml.doe.gov

Office of Science and Technology Web Page: http://ost.em.doe.gov

Environmental Measurements Laboratory
U.S. Department of Energy
201 Varick Street, 5th Floor
New York, NY 10014-4811